

Amendments to the Claims

Please cancel claims 4510 and 4558-4603 without prejudice.

The following listing of claims will replace all prior versions and/or listings of claims in the application:

Listing of Claims:

1-4499. (cancelled)

4500. (currently amended): A method for in situ production of synthesis gas from a coal formation, comprising:

heating a section of the formation to a temperature sufficient to allow synthesis gas generation, wherein a permeability of the section is substantially uniform and greater than a permeability of an unheated section of the formation when the temperature sufficient to allow synthesis gas generation in the formation is achieved;

providing a synthesis gas generating fluid to the section to generate synthesis gas;

controlling the heating of the section and provision of the synthesis gas generating fluid to maintain a temperature in the section above the temperature sufficient to generate synthesis gas;
and

removing synthesis gas from the formation.

4501. (previously presented): The method of claim 4500, wherein the permeability of the section is greater than about 100 millidarcy when the temperature sufficient to allow synthesis gas generation in the formation is achieved.

4502. (original): The method of claim 4500, wherein the temperature sufficient to allow synthesis gas generation ranges from approximately 400 °C to approximately 1200 °C.

4503. (original): The method of claim 4500, further comprising heating the section when providing the synthesis gas generating fluid to inhibit temperature decrease in the section due to synthesis gas generation.

4504. (previously presented): The method of claim 4500, wherein heating the section comprises convecting an oxidizing fluid into a portion of the section, wherein the temperature in the section is above a temperature sufficient to support oxidation of carbon in the section with the oxidizing fluid, and reacting the oxidizing fluid with carbon in the section to generate heat in the section.

4505. (original): The method of claim 4504, wherein the oxidizing fluid comprises air.

4506. (original): The method of claim 4505, wherein an amount of the oxidizing fluid convected into the section is configured to inhibit formation of oxides of nitrogen by maintaining a reaction temperature below a temperature sufficient to produce oxides of nitrogen compounds.

4507. (currently amended): The method of claim 4500, wherein heating the section comprises diffusing an oxidizing fluid to ~~reaction~~-zones adjacent to wellbores in the formation, oxidizing carbon in the ~~reaction-zone~~zones to generate heat, and transferring the heat to the section.

4508. (withdrawn): The method of claim 4500, wherein heating the section comprises heating the section by transfer of heat from one or more electrical heaters.

4509. (withdrawn): The method of claim 4500, wherein heating the section to a temperature sufficient to allow synthesis gas generation and providing a synthesis gas generating fluid to the section comprises introducing steam to the section to heat the formation and to generate synthesis gas.

4510. (cancelled)

4511. (previously presented): The method of claim 4500, further comprising:
monitoring a composition of the produced synthesis gas; and
controlling heating of the section and provision of the synthesis gas generating fluid to
maintain the composition of the produced synthesis gas in a selected range.
4512. (original): The method of claim 4511, wherein the selected range comprises a ratio of H₂
to CO of about 2:1.
4513. (original): The method of claim 4500, wherein the synthesis gas generating fluid
comprises liquid water.
4514. (original): The method of claim 4500, wherein the synthesis gas generating fluid
comprises steam.
4515. (previously presented): The method of claim 4500, wherein the synthesis gas generating
fluid comprises water and carbon dioxide, and wherein the carbon dioxide inhibits production of
carbon dioxide from carbon containing material in the section.
4516. (previously presented): The method of claim 4515, wherein a portion of the carbon
dioxide in the synthesis gas generating fluid comprises carbon dioxide removed from the
formation.
4517. (original): The method of claim 4500, wherein the synthesis gas generating fluid
comprises carbon dioxide, and wherein a portion of the carbon dioxide reacts with carbon in the
formation to generate carbon monoxide.
4518. (previously presented): The method of claim 4517, wherein a portion of the carbon
dioxide in the synthesis gas generating fluid comprises carbon dioxide removed from the
formation.

4519. (original): The method of claim 4500, wherein providing the synthesis gas generating fluid to the section comprises raising a water table of the formation to allow water to flow into the section.

4520. (original): The method of claim 4500, wherein the synthesis gas is removed from a producer well equipped with a heating source, and wherein a portion of the heating source adjacent to a synthesis gas producing zone operates at a substantially constant temperature to promote production of the synthesis gas wherein the synthesis gas has a selected composition.

4521. (original): The method of claim 4520, wherein the substantially constant temperature is about 700 °C, and wherein the selected composition has a H₂ to CO ratio of about 2:1.

4522. (previously presented): The method of claim 4500, wherein the synthesis gas generating fluid comprises water and hydrocarbons having carbon numbers less than 5, and wherein at least a portion of the hydrocarbons are subjected to a reaction in the section to increase a H₂ concentration of the generated synthesis gas.

4523. (previously presented): The method of claim 4500, wherein the synthesis gas generating fluid comprises water and hydrocarbons having carbon numbers greater than 4, and wherein at least a portion of the hydrocarbons react in the section to increase an energy content of the synthesis gas removed from the formation.

4524. (previously presented): The method of claim 4500, further comprising maintaining a pressure in the formation during synthesis gas generation, and passing produced synthesis gas through a turbine to generate electricity.

4525. (original): The method of claim 4500, further comprising generating electricity from the synthesis gas using a fuel cell.

4526. (currently amended): The method of claim 4500, wherein the formation comprises a spent portion, and further comprising generating electricity from the synthesis gas using a fuel cell, separating carbon dioxide from a fluid exiting the fuel cell, and storing a portion of the separated carbon dioxide in ~~a~~ the spent section ~~portion~~ of the formation.

4527. (withdrawn): The method of claim 4500, further comprising using a portion of the synthesis gas as a combustion fuel to heat the formation.

4528. (original): The method of claim 4500, further comprising converting at least a portion of the produced synthesis gas to condensable hydrocarbons using a Fischer-Tropsch synthesis process.

4529. (original): The method of claim 4500, further comprising converting at least a portion of the produced synthesis gas to methanol.

4530. (original): The method of claim 4500, further comprising converting at least a portion of the produced synthesis gas to gasoline.

4531. (original): The method of claim 4500, further comprising converting at least a portion of the synthesis gas to methane using a catalytic methanation process.

4532. (currently amended): The method of claim 4500, ~~further comprising~~ wherein heating the section of the formation comprises providing heat from three or more heat sources to at least a part of the formation, wherein three or more of the heat sources are located in the formation in a unit of heat sources, and wherein the unit of heat sources comprises a triangular pattern.

4533. (currently amended): The method of claim 4500, ~~further comprising~~ wherein heating the section of the formation comprises providing heat from three or more heat sources to at least a part of the formation, wherein three or more of the heat sources are located in the formation in a unit of heat sources, wherein the unit of heat sources comprises a triangular pattern, and wherein

a plurality of the units are repeated over an area of the formation to form a repetitive pattern of units.

4534. (previously presented): A method of treating a coal formation in situ, comprising:
providing heat from one or more heat sources to at least a section of the formation;
allowing the heat to transfer from the one or more heat sources to increase a permeability of the section such that the permeability of the section is substantially uniform, and to increase a temperature of the section to a temperature sufficient to allow synthesis gas generation;
providing a synthesis gas generating fluid to at least the section of the formation, wherein the synthesis gas generating fluid comprises carbon dioxide;
obtaining a portion of the carbon dioxide of the synthesis gas generating fluid from the formation; and
producing synthesis gas from the formation.

4535. (previously presented): The method of claim 4534, wherein the temperature sufficient to allow synthesis gas generation is in a range from about 400 °C to about 1200 °C.

4536. (currently amended): The method of claim 4534, further comprising using a ~~second~~another portion of the ~~separated~~carbon dioxide of the synthesis gas generating fluid as a flooding agent to produce hydrocarbon bed methane from a coal formation.

4537. (original): The method of claim 4536, wherein the coal formation is a deep coal formation over 760 m below ground surface.

4538. (original): The method of claim 4536, wherein the coal formation adsorbs some of the carbon dioxide to sequester the carbon dioxide.

4539. (currently amended): The method of claim 4534, further comprising using a ~~second~~another portion of the ~~separated~~carbon dioxide of the synthesis gas generating fluid as a flooding agent for enhanced oil recovery.

4540. (currently amended): The method of claim 4534, wherein the synthesis gas generating fluid further comprises water and hydrocarbons having carbon numbers less than 5, and wherein at least a portion of the hydrocarbons undergo a reaction in the section to increase a H₂ concentration in the produced synthesis gas.

4541. (currently amended): The method of claim 4534, wherein the synthesis gas generating fluid further comprises water and hydrocarbons having carbon numbers greater than 4, and wherein at least a portion of the hydrocarbons react in the section to increase an energy content of the produced synthesis gas.

4542. (previously presented): The method of claim 4534, further comprising maintaining a pressure in the formation during synthesis gas generation, and passing produced synthesis gas through a turbine to generate electricity.

4543. (original): The method of claim 4534, further comprising generating electricity from the synthesis gas using a fuel cell.

4544. (currently amended): The method of claim 4534, wherein the formation comprises a spent portion, and further comprising generating electricity from the synthesis gas using a fuel cell, separating carbon dioxide from a fluid exiting the fuel cell, and storing a portion of the separated carbon dioxide in at the spent section-portion of the formation.

4545. (withdrawn): The method of claim 4534, further comprising using a portion of the synthesis gas as a combustion fuel for heating the formation.

4546. (original): The method of claim 4534, further comprising converting at least a portion of the produced synthesis gas to condensable hydrocarbons using a Fischer-Tropsch synthesis process.

4547. (original): The method of claim 4534, further comprising converting at least a portion of the produced synthesis gas to methanol.

4548. (original): The method of claim 4534, further comprising converting at least a portion of the produced synthesis gas to gasoline.

4549. (original): The method of claim 4534, further comprising converting at least a portion of the synthesis gas to methane using a catalytic methanation process.

4550. (previously presented): The method of claim 4534, wherein a temperature of the one or more heat sources is maintained at a temperature of less than approximately 700 °C to produce a synthesis gas having a ratio of H₂ to carbon monoxide of greater than about 2.

4551. (previously presented): The method of claim 4534, wherein a temperature of the one or more heat sources is maintained at a temperature of greater than approximately 700 °C to produce a synthesis gas having a ratio of H₂ to carbon monoxide of less than about 2.

4552. (previously presented): The method of claim 4534, wherein a temperature of the one or more heat sources is maintained at a temperature of approximately 700 °C to produce a synthesis gas having a ratio of H₂ to carbon monoxide of approximately 2.

4553. (withdrawn): The method of claim 4534, wherein at least one of the heat sources comprises an electrical heater.

4554. (previously presented): The method of claim 4534, wherein at least one of the heat sources comprises a natural distributed heater.

4555. (withdrawn): The method of claim 4534, wherein at least one of the heat sources comprises a flameless distributed combustor (FDC) heater, and wherein fluids are produced from a wellbore of the FDC heater through a conduit positioned in the wellbore.

4556. (previously presented): The method of claim 4534, further comprising providing heat from three or more heat sources to at least a part of the formation, wherein three or more of the heat sources are located in the formation in a unit of heat sources, and wherein the unit of heat sources comprises a triangular pattern.

4557. (previously presented): The method of claim 4534, further comprising providing heat from three or more heat sources to at least a part of the formation, wherein three or more of the heat sources are located in the formation in a unit of heat sources, wherein the unit of heat sources comprises a triangular pattern, and wherein a plurality of the units are repeated over an area of the formation to form a repetitive pattern of units.

4558-5149. (cancelled)

Amendments to the Drawings

The attached seven (7) sheets of formal drawings include changes to FIGS. 23a, 23b, 32, 44, 54, 55, 59, 60, and 63 approved by the Examiner. These sheets replace the original sheets including the same figures.

Attachment: Replacement Sheets